Apprenticeship and Industry Training

Millwright

Apprenticeship Course Outline

1613 (2013)

Alberta

Apprenticeship and Industry Training

ALBERTA ENTERPRISE AND ADVANCED EDUCATION

Millwright apprenticeship course outline

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Millwright
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Apprenticeship

Apprenticeship is post-secondary education with a difference. Apprenticeship begins with finding an employer. Employers hire apprentices, pay their wages and provide on-the-job training and work experience. Approximately 80 per cent of an apprentice's time is spent on the job under the supervision of a certified journeyperson or qualified tradesperson. The other 20 per cent involves technical training provided at, or through, a post-secondary institution – usually a college or technical institute.

To become certified journeypersons, apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board on the recommendation of Millwright Provincial Apprenticeship Committee.

The graduate of the Millwright apprenticeship program is a certified journeyperson who will be able to:

- understand the principles of sound and safe trade practice
- interpret drawings, plans, and be able to layout and develop projects according to specifications
- use the tools of the trade in a safe and proper manner
- relate to the work of other tradespeople employed in the industry either on construction or in maintenance
- perform assigned tasks in accordance with quality and production standards required in industry
- perform assigned tasks in accordance with quality and production standards required by industry

Apprenticeship and Industry Training System

Industry-Driven

Alberta's apprenticeship and industry training system is an industry-driven system that ensures a highly skilled, internationally competitive workforce in more than 50 designated trades and occupations. This workforce supports the economic progress of Alberta and its competitive role in the global market. Industry (employers and employees) establishes training and certification standards and provides direction to the system through an industry committee network and the Alberta Apprenticeship and Industry Training Board. The Alberta government provides the legislative framework and administrative support for the apprenticeship and industry training system.

Alberta Apprenticeship and Industry Training Board

The Alberta Apprenticeship and Industry Training Board provide a leadership role in developing Alberta's highly skilled and trained workforce. The board's primary responsibility is to establish the standards and requirements for training and certification in programs under the Apprenticeship and Industry Training Act. The board also provides advice to the Minister of Advanced Education on the needs of Alberta's labour market for skilled and trained workers, and the designation of trades and occupations.

The thirteen-member board consists of a chair, eight members representing trades and four members representing other industries. There are equal numbers of employer and employee representatives.

Industry Committee Network

Alberta's apprenticeship and industry training system relies on a network of industry committees, including local and provincial apprenticeship committees in the designated trades, and occupational committees in the designated occupations. The network also includes other committees such as provisional committees that are established before the designation of a new trade or occupation comes into effect. All trade committees are composed of equal numbers of employer and employee representatives. The industry committee network is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the board can set up a local apprenticeship committee. The board appoints equal numbers of employee and employer representatives for terms of up to three years. The committee appoints a member as presiding officer. Local apprenticeship committees:

- monitor apprenticeship programs and the progress of apprentices in their trade, at the local level
- make recommendations to their trade's provincial apprenticeship committee (PAC) about apprenticeship and certification in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- make recommendations to the board about the appointment of members to their trade's PAC
- help settle certain kinds of disagreements between apprentices and their employers
- carry out functions assigned by their trade's PAC or the board

Provincial Apprenticeship Committees (PAC)

The board establishes a provincial apprenticeship committee for each trade. It appoints an equal number of employer and employee representatives, and, on the PAC's recommendation, a presiding officer - each for a maximum of two terms of up to three years. Most PAC's have nine members but can have as many as twenty-one. Provincial apprenticeship committees:

- Make recommendations to the board about:
    - standards and requirements for training and certification in their trade
    - courses and examinations in their trade
    - apprenticeship and certification
    - designation of trades and occupations
    - regulations and orders under the Apprenticeship and Industry Training Act
- monitor the activities of local apprenticeship committees in their trade
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- consult with other committees under the Apprenticeship and Industry Training Act about apprenticeship programs, training and certification and facilitate cooperation between different trades and occupations
- consult with organizations, associations and people who have an interest in their trade and with employers and employees in their trade
- may participate in resolving certain disagreements between employers and employees
- carry out functions assigned by the board

Millwright PAC Members at the Time of Publication

Mr. L. Lisitza	Ft. Saskatchewan	Presiding Officer
Mr. C. Dyke	Red Deer	Employer
Mr. W. Gajetzki	Airdrie	Employer
Mr. M. Pelletier	Legal	Employer
Mr. J. Travnik	Sherwood Park	Employee
Mr. O. Burke	Fort McMurray	Employee
Mr. S. Ward	Calgary	Employee
Mr. T. Tomkiewych	Hinton	Employee

Alberta Government

Alberta Advanced Education works with industry, employer and employee organizations and technical training providers to:

- facilitate industry's development and maintenance of training and certification standards
- provide registration and counselling services to apprentices and employers
- coordinate technical training in collaboration with training providers
- certify apprentices and others who meet industry standards

Technical Institutes and Colleges

The technical institutes and colleges are key participants in Alberta's apprenticeship and industry training system. They work with the board, industry committees and Alberta Advanced Education to enhance access and responsiveness to industry needs through the delivery of the technical training component of apprenticeship programs. They develop lesson plans from the course outlines established by industry and provide technical training to apprentices.

Apprenticeship Safety

Safe working procedures and conditions, incident/injury prevention, and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees, apprentices and the public. Therefore, it is imperative that all parties are aware of circumstances that may lead to injury or harm.

Safe learning experiences and healthy environments can be created by controlling the variables and behaviours that may contribute to or cause an incident or injury. By practicing a safe and healthy attitude, everyone can enjoy the benefit of an incident and injury free environment.

Alberta Apprenticeship and Industry Training Board Safety Policy

The Alberta Apprenticeship and Industry Training Board (board) fully supports safe learning and working environments and emphasizes the importance of safety awareness and education throughout apprenticeship training- in both on-the- job training and technical training. The board also recognizes that safety awareness and education begins on the first day of on-the-job training and thereby is the initial and ongoing responsibility of the employer and the apprentice as required under workplace health and safety training. However the board encourages that safe workplace behavior is modeled not only during on-the-job training but also during all aspects of technical training, in particular, shop or lab instruction. Therefore the board recognizes that safety awareness and training in apprenticeship technical training reinforces, but does not replace, employer safety training that is required under workplace health and safety legislation.

The board has established a policy with respect to safety awareness and training:

> **The board promotes and supports safe workplaces, which embody a culture of safety for all apprentices, employers and employees. Employer required safety training is the responsibility of the employer and the apprentice, as required under legislation other than the *Apprenticeship and Industry Training Act*.**

The board's complete document on its 'Apprenticeship Safety Training Policy' is available at www.tradesecrets.alberta.ca; access the website and conduct a search for 'safety training policy'.

Implementation of the policy includes three common safety learning outcomes and objectives for all trade course outlines. These common learning outcomes ensure that each course outline utilizes common language consistent with workplace health and safety terminology. Under the title of 'Standard Workplace Safety', this first section of each trade course outline enables the delivery of generic safety training; technical training providers will provide trade specific examples related to the content delivery of course outline safety training.

Occupational Health and Safety

A tradesperson is often exposed to more hazards than any other person in the work force and therefore should be familiar with and apply the Occupational Health and Safety Act, Regulations and Code when dealing with personal safety and the special safety rules that apply to all daily tasks.

Occupational Health and Safety (A division of Alberta Human Services) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at www.humanservice.alberta.ca

Technical Training

Apprenticeship technical training is delivered by the technical institutes and many colleges in the public post-secondary system throughout Alberta. The colleges and institutes are committed to delivering the technical training component of Alberta apprenticeship programs in a safe, efficient and effective manner. All training providers place great emphasis on safe technical practices that complement safe workplace practices and help to develop a skilled, safe workforce.

The following institutions deliver Millwright apprenticeship technical training:

Northern Alberta Institute of Technology
Keyano College
Red Deer College
Southern Alberta Institute of Technology
Grande Prairie Regional College

Procedures for Recommending Revisions to the Course Outline

Advanced Education has prepared this course outline in partnership with the Millwright Provincial Apprenticeship Committee.

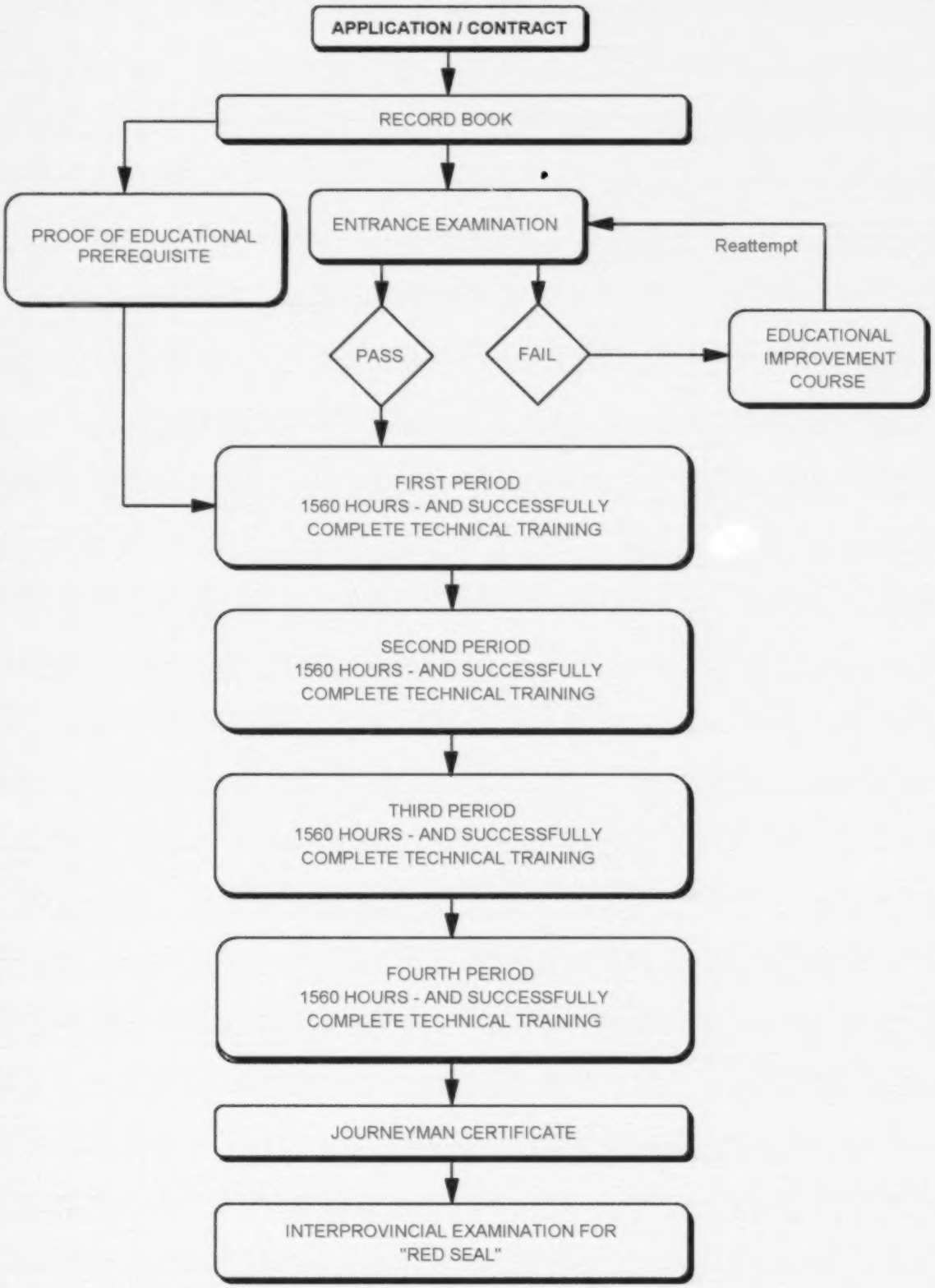
This course outline was approved on December 14, 2012 by the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. The valuable input provided by representatives of industry and the institutions that provide the technical training is acknowledged.

Any concerned individual or group in the province of Alberta may make recommendations for change by writing to:

Millwright Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
Advanced Education
10th floor, Commerce Place
10155 102 Street NW
Edmonton AB. T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used. Recommendations for change will be placed on the agenda for regular meetings of the Millwright Provincial Apprenticeship Committee.

Apprenticeship Route toward Certification



Millwright Training Profile
First Period
(8 Weeks 30 Hours per Week – Total of 240 Hours)

SECTION ONE

SAFETY, RIGGING, CRANES AND HOISTS
30 HOURS

A	B	C
Safety Legislation, Regulation & Industry Policy in the Trades 8 Hours	Climbing, Lifting, Rigging and Hoisting 2 Hours	Hazardous Materials & Fire Protection 2 Hours

D	E
Rigging Procedures 14 Hours	Crane and Hoists 4 Hours

SECTION TWO

MEASUREMENT, LAYOUT AND METALLURGY
34 HOURS

A	B	C
Measuring 6 Hours	Measuring Tools 12 Hours	Layout 6 Hours

D
Metallurgy 10 Hours

SECTION THREE

TOOLS AND FASTENERS
36 HOURS

A	B	C
Hand Tools 8 Hours	Portable Power and Air Tools 6 Hours	Grinders 2 Hours

D	E	F
Power Saws 2 Hours	Explosive Actuated Tools 4 Hours	Threaded Fasteners and Locking Devices 6 Hours

G	H
Non-Threaded Fasteners and Locking Devices 4 Hours	Installation and Removal of Fasteners 4 Hours

SECTION FOUR

MACHINING
64 HOURS

A	B	C
Drilling 10 Hours	Milling 10 Hours	Lathe Components and Accessories 20 Hours

D
Lathe Operations 24 Hours

SECTION FIVE

MACHINE INSTALLATION AND ALIGNMENT
24 HOURS

A	B
Grouting, Levelling, and Anchoring 6 Hours	Rim and Face Shaft Alignment 18 Hours

SECTION SIX

MATH & PRINT READING

52 HOURS

A	B	C
Working With Numbers 2 Hours	Fractions and Decimals 6 Hours	Algebra 6 Hours
D	**E**	**F**
Measurements and Conversions 4 Hours	Ratio & Proportion, Graphs and Tables 6 Hours	Introduction to Triangles and Trigonometry 8 Hours
G	**H**	
Sketches, Drawings and Prints 10 Hours	Limits, Fits and Tolerances 10 Hours	

Second Period
(8 Weeks 30 Hours per week – Total of 240 Hours)

SECTION ONE

BEARINGS, GASKETS, SEALS AND LUBRICATION
48 HOURS

A	B	C
Gaskets and Piping 10 Hours	Anti-Friction Bearings 12 Hours	Plain Bearings 8 Hours
D	**E**	**F**
Bearing Maintenance 6 Hours	Bearing Seals and Pillow Blocks 4 Hours	Lubrication 8 Hours

SECTION TWO

POWER TRANSMISSION
56 HOURS

A	B	C
Shafting, Fits and Accessories 6 Hours	Couplings 10 Hours	Clutches and Brakes 8 Hours
D	**E**	**F**
Belts 8 Hours	Chains 8 Hours	Gearing Fundamentals 4 Hours
G		
Gearing Installation and Maintenance 8 Hours	Variable Speed Power Transmission Devices 4 Hours	

SECTION THREE

RECIPROCATING COMPRESSORS
50 HOURS

A	B	C
Compressor Fundamentals 12 Hours	Compressor Valves 8 Hours	Compressor Cylinder Components 6 Hours
D	**E**	**F**
Compressor Crosshead and Distance Piece Components 6 Hours	Compressor Crankshaft and Frame Components 6 Hours	Compressor Auxiliary Systems 12 Hours
G		
Compressor Overhaul and Start-up Procedures 10 Hours		

SECTION FOUR

ALIGNMENT, CUTTING, WELDING AND NON- DESTRUCTIVE TESTING
36 HOURS

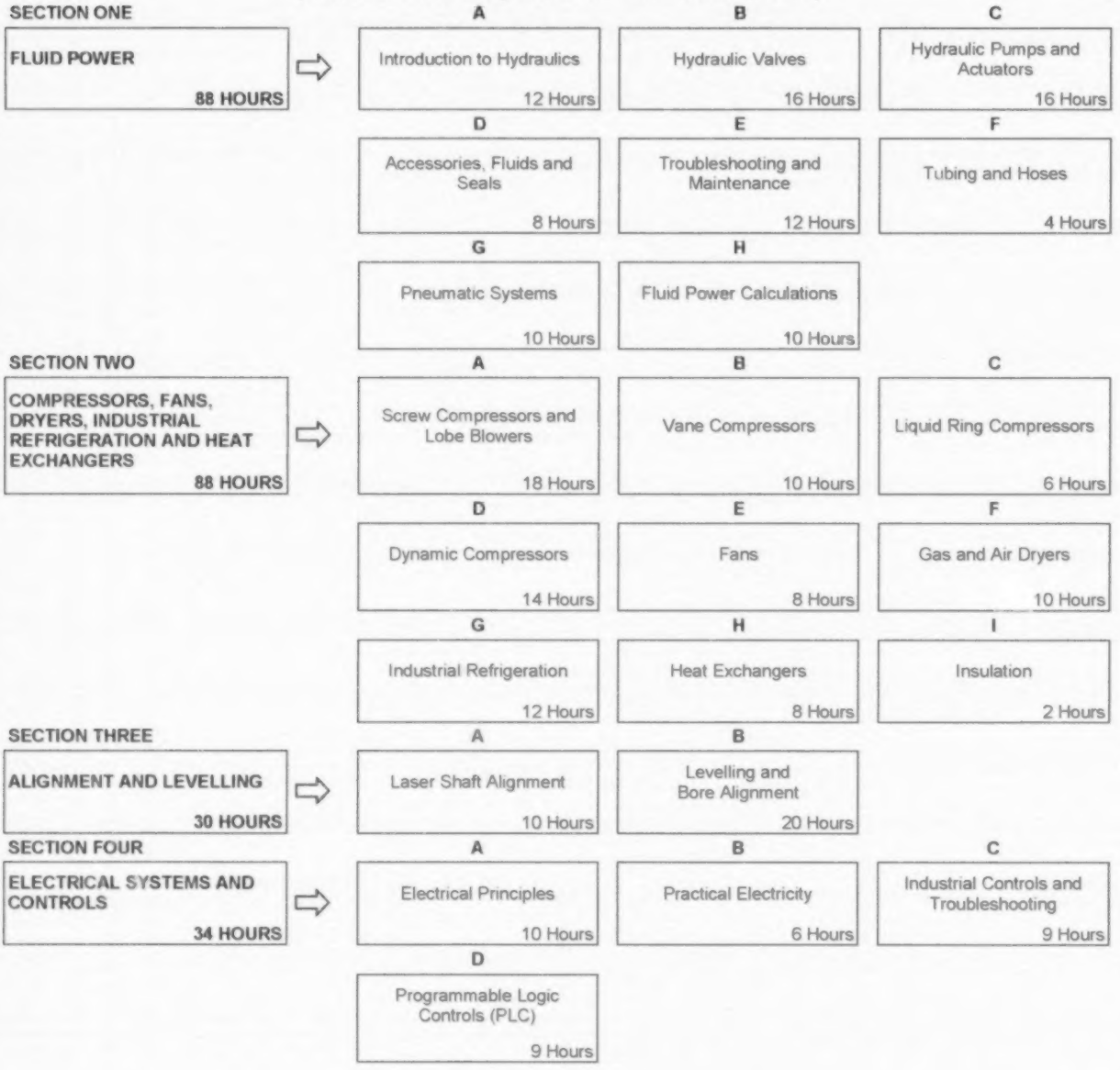
A	B	C
Cross Dial Alignment 16 Hours	Oxy-Fuel Equipment and Procedures 8 Hours	Electric Arc Welding 8 Hours
D		
Non-Destructive Testing 4 Hours		

SECTION FIVE

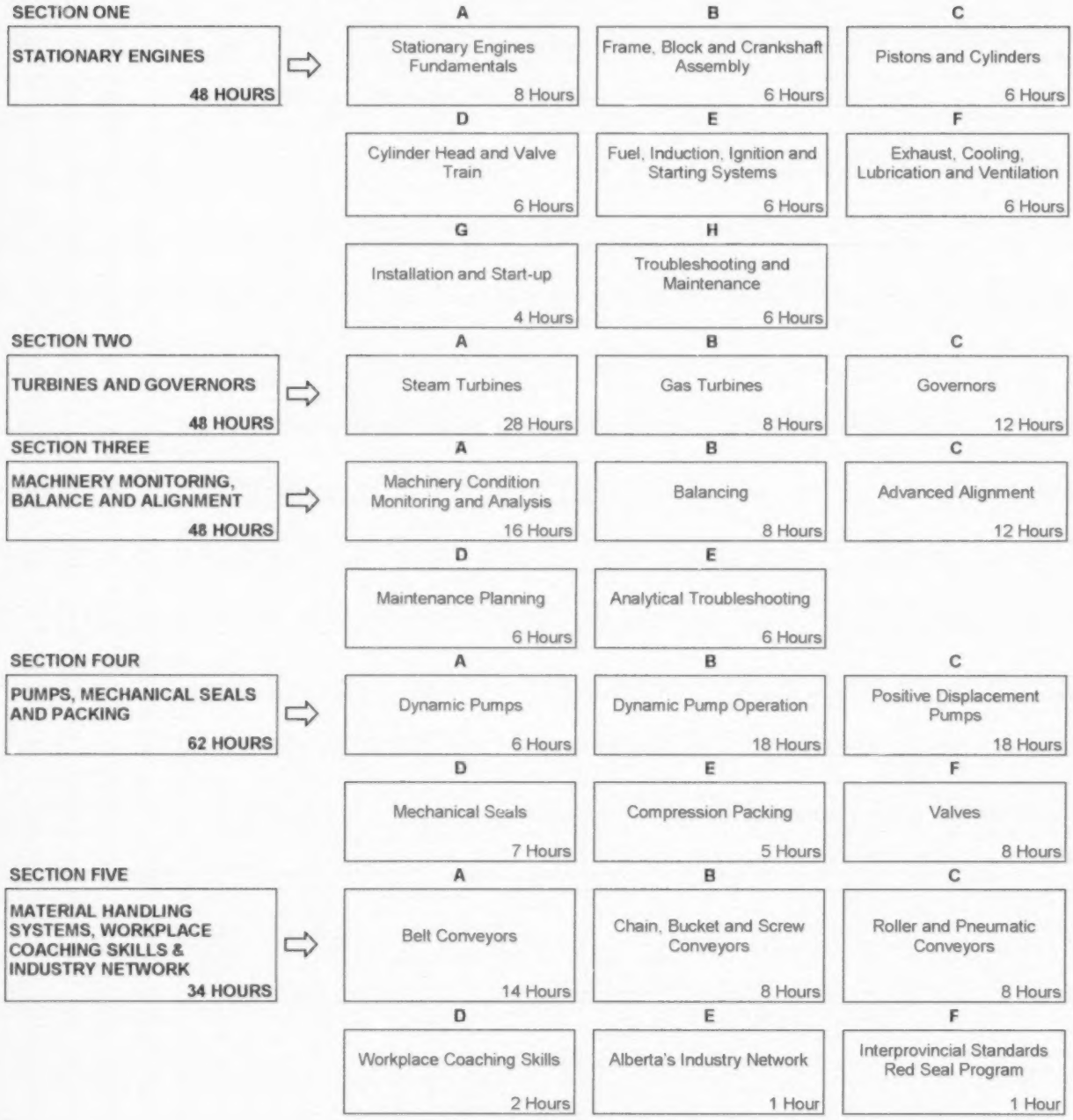
MATH & PRINT READING
40 HOURS

A	B	C
Area, Volume and Capacities 8 Hours	Transmission of Force and Motion 8 Hours	Gas Laws and Coefficient of Linear Expansion 8 Hours
D	**E**	**F**
Auxiliary Views and Assembly Drawings 6 Hours	Single Line Drawings 6 Hours	Basic Joints, Weld Types and Symbols 4 Hours

Third Period
(8 Weeks 30 Hours per week – Total of 240 Hours)



Fourth Period
(8 Weeks 30 Hours per week – Total of 240 Hours)



NOTE: The hours stated are for guidance and should be adhered to as closely as possible. However, adjustments must be made for rate of apprentice learning, statutory holidays, registration and examinations for the training establishment and Apprenticeship and Industry Training.

FIRST PERIOD TECHNICAL TRAINING
MILLWRIGHT TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE WILL BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

Due to the nature of the work of the Millwright trade it is imperative that safety, WHMIS and environmental concerns be taught on a continuous basis throughout the entirety of this course.

It is industry's intent that the practical portion of the program enhances the theory section of the course outline.

SECTION ONE: .....SAFETY, RIGGING, CRANES AND HOISTS..... 30 HOURS

A. Safety Legislation, Regulation & Industry Policy in the Trades .....8 Hours

Outcome: ***Describe legislation, regulations and practices intended to ensure a safe work place in this trade.***

1. Demonstrate the ability to apply the Occupational Health and Safety Act, Regulation and Code.
2. Explain the role of the employer and employee in regard to Occupational Health and Safety (OH&S) regulations, Worksite Hazardous Materials Information Systems (WHMIS), fire regulations, Workers Compensation Board regulations, and related advisory bodies and agencies.
3. Explain industry practices for hazard assessment and control procedures.
4. Describe the responsibilities of workers and employers to apply emergency procedures.
5. Describe positive tradesperson attitudes with respect to housekeeping, personal protective equipment and emergency procedures.
6. Describe the roles and responsibilities of employers and employees with respect to the selection and use of personal protective equipment (PPE).
7. Select, use and maintain appropriate PPE for worksite applications.

B. Climbing, Lifting, Rigging and Hoisting .....2 Hours

Outcome: ***Describe the use of personal protective equipment (PPE) and safe practices for climbing, lifting, rigging and hoisting in this trade.***

1. Select, use and maintain specialized PPE for climbing, lifting and load moving equipment.
2. Describe manual lifting procedures using correct body mechanics.
3. Describe rigging hardware and the safety factor associated with each item.
4. Select the correct equipment for rigging typical loads.
5. Describe hoisting and load moving procedures.

C. Hazardous Materials & Fire Protection .....2 Hours

Outcome: ***Describe the safety practices for hazardous materials and fire protection in this trade.***

1. Describe the roles, responsibilities features and practices related to the workplace hazardous materials information system (WHMIS) program.
2. Describe the three key elements of WHMIS.
3. Describe handling, storing and transporting procedures when dealing with hazardous material.

4. Describe safe venting procedures when working with hazardous materials.
5. Describe fire hazards, classes, procedures and equipment related to fire protection.

D. Rigging Procedures ..... 14 Hours

Outcome: Describe rigging and hoisting equipment and procedures.

1. Describe the construction of wire rope.
2. Describe the construction and use of steel and fibre slings.
3. Describe hoisting equipment hardware.
4. Describe construction and use of chain and chain slings.
5. Describe the construction of fibre rope and the purpose and use of knots.
6. Estimate the weight of various objects when given the size, shape and material.
7. Describe hand-rigging equipment.
8. Describe standard hand signals used for rigging and hoisting operations.
9. Demonstrate hoisting and load moving procedures.

E. Cranes and Hoists ..... 4 Hours

Outcome: Describe cranes and hoists for lifting and moving objects.

1. Describe types of mobile cranes.
2. Describe set up and safety procedures for mobile cranes.
3. Describe electric overhead travelling cranes.
4. Describe electric overhead travelling crane inspection procedures.

SECTION TWO: ..... MEASURING, LAYOUT AND METALLURGY ..... 34 HOURS

A. Measuring ..... 6 Hours

Outcome: Describe measuring fundamentals for the millwright trade.

1. Describe measurement units, standards and systems.
2. Describe the effect of temperature change on the dimensions of objects being measured, with regard to various materials.

B. Measuring Tools ..... 12 Hours

Outcome: Demonstrate measuring procedures used in the millwright trade.

1. Describe basic measuring tools and their uses.
2. Describe precision measuring tools and their uses.
3. Describe transfer measurement.
4. Describe measurement using dial indicators.
5. Demonstrate the use of measuring tools used in the millwright trade.

C. Layout ..... **6 Hours**

Outcome: ***Describe layout procedures and tools.***

1. Describe tools used for layout procedures.
2. Demonstrate layout procedures.

D. Metallurgy ..... **10 Hours**

Outcome: ***Describe composition and properties of metals.***

1. Describe metals by visual appearance, colour, relative weight, typical shape and texture.
2. Describe the physical properties of metals.
3. Describe metal manufacturing processes.
4. Describe types and classifications of metals.
5. Describe the heat treatment of metals.
6. Describe tensile and hardness testing of metals.
7. Describe chip, spark, file hardness and flame tests.
8. Describe the use of mill test reports.

SECTION THREE: ..... TOOLS AND FASTNERS ..... 36 HOURS

A. Hand Tools ..... **8 Hours**

Outcome: ***Demonstrate use and maintenance of hand tools.***

1. Describe hand held tools used for performing bench-work procedures.
2. Describe hydraulic jacks, pullers and presses.
3. Describe methods used for cleaning machine parts.
4. Describe the use of bonded abrasives and the process of hand lapping.
5. Describe care and use of taps and dies.
6. Describe care and use of hand reamers and broaches.
7. Demonstrate maintenance and use of hand held tools.

B. Portable Power and Air Tools ..... **6 Hours**

Outcome: ***Demonstrate and maintain portable power and air tools.***

1. Describe safety rules pertaining to portable power and air tools.
2. Describe portable power tools, their operation, application and attachments.
3. Describe air tools, components, their operation, application and attachments.
4. Demonstrate maintenance and use of portable power and air tools.

C. Grinders ..... **2 Hours**

Outcome: ***Demonstrate and maintain grinders.***

1. Describe safety rules pertaining to offhand grinder use.
2. Describe operation, types, parts and application of offhand grinders.

3. Describe grinding wheel selection, installation and maintenance procedures.
4. Demonstrate maintenance and use of grinders.

D. Power Saws .....2 Hours

Outcome: Demonstrate and maintain power saws.

1. Describe power hacksaws, their operation, application and attachments.
2. Describe band saws, their operation, application and attachments.
3. Describe abrasive cut-off saws, their operation, application and attachments.
4. Demonstrate maintenance and use of power saws.

E. Explosive Actuated Tools .....4 Hours

Outcome: Demonstrate explosive actuated tools, loads and fasteners.

1. Describe explosive actuated tool power loads, power load strength and safety requirements.
2. Describe explosive actuated tool fasteners, accessories and applications.
3. Assess base material suitability and related fastening requirements.
4. Describe explosive actuated system safety, firing procedure and tool maintenance.
5. Demonstrate maintenance and use of explosive actuated tools.

F. Threaded Fasteners and Locking Devices .....6 Hours

Outcome: Demonstrate use of threaded fasteners and locking devices.

1. Describe personal safety equipment required when working with threaded fasteners and anchors.
2. Describe threaded fasteners and locking devices and their applications.
3. Describe metric and imperial thread classes and fits.
4. Describe types and purposes of threads and thread forms.
5. Describe thread measuring tools, methods and procedures.
6. Demonstrate use of threaded fasteners and locking devices.

G. Non-Threaded Fasteners and Locking Devices .....4 Hours

Outcome: Demonstrate use of non-threaded fasteners and locking devices.

1. Describe non-threaded fasteners and locking devices and their applications.
2. Demonstrate use of non-threaded fasteners and locking devices.

H. Installation and Removal of Fasteners .....4 Hours

Outcome: Describe installation and removal of fasteners.

1. Describe the theory and methods of tensioning.
2. Describe the removal of broken fasteners
3. Describe thread reconditioning.

SECTION FOUR: .....MACHINING..... 64 HOURS

A. Drilling .....10 Hours

Outcome: ***Demonstrate procedures for operating drilling machines.***

1. Describe safety, types, components and applications of drilling machines.
2. Describe work holding and tool holding devices.
3. Describe drilling tools and their applications.
4. Explain operation, speeds and feeds of drilling machines.
5. Describe care and maintenance of drilling tools and machines
6. Demonstrate use and maintenance of drilling machines.

B. Milling .....10 Hours

Outcome: ***Demonstrate procedures for operating milling machines.***

1. Describe safety, types, components and applications of milling machines.
2. Describe milling tools and accessories and their applications.
3. Explain operation, speeds and feeds of milling machines.
4. Describe maintenance of milling machines.
5. Demonstrate use and maintenance of milling machines.

C. Lathe Components and Accessories .....20 Hours

Outcome: ***Describe lathe components and accessories.***

1. Describe lathe safety.
2. Describe construction of lathes.
3. Describe work holding and tool holding devices.
4. Describe lathe accessories.
5. Describe cutting and forming tools and sharpening procedures.
6. Describe lathe maintenance.
7. Describe the application of tapers.
8. Describe manufacture and repairs of tapers.

D. Lathe Operations .....24 Hours

Outcome: ***Demonstrate procedures for operating lathes.***

1. Describe lathe turning operations.
2. Describe lathe drilling, boring, and reaming operations.
3. Describe lathe threading operations.
4. Describe lathe polishing, knurling and grinding operations.
5. Describe applications for cutting fluids.
6. Demonstrate use and maintenance of lathes.

SECTION FIVE: MACHINE INSTALLATION AND ALIGNMENT ..... 24 HOURS

A. Grouting, Levelling, and Anchoring ..... 6 Hours

Outcome: Describe machine levelling, anchoring and grouting procedures.

1. Describe levelling tools, equipment and procedures.
2. Describe types, purposes and procedures for grouting.
3. Describe types of anchors and installation procedures.

B. Rim and Face Shaft Alignment ..... 18 Hours

Outcome: Demonstrate rim and face shaft alignment.

1. Describe the reasons for aligning machine shafts.
2. Describe pre-alignment procedures.
3. Describe rim and face method of shaft alignment.
4. Demonstrate procedures to align two machine shafts using the rim and face formula method.

SECTION SIX: MATH AND PRINT READING ..... 52 HOURS

A. Working with Numbers ..... 2 Hours

Outcome: Perform mathematical operations with whole numbers.

1. Read whole numbers by using place values and perform rounding operations.
2. Perform addition and subtractions with whole numbers.
3. Perform multiplication and divisions with whole numbers.
4. Identify signed numbers and perform operations with such numbers.

B. Fractions and Decimals ..... 6 Hours

Outcome: Solve problems involving fractions and decimals.

1. Identify key terms and concepts used when working with fractions.
2. Change fractions to common denominators.
3. Solve problems using fractions and mixed numbers.
4. Solve problems using decimal fractions and decimal numbers.
5. Round decimal numbers to specified place values.
6. Convert between decimal numbers and fractions.

C. Algebra ..... 6 Hours

Outcome: Perform mathematical operations using algebra.

1. Describe algebraic functions.
2. Demonstrate the order of operations.
3. Solve problems using algebraic formulas.

D. Measurement and Conversions ..... 4 Hours

Outcome: ***Solve problems involving measurement and conversion.***

1. Describe systems for linear, angular, weight and capacity measurement.
2. Describe geometric shapes used in the millwright trade.
3. Describe formulas and solve problems for perimeter.
4. Describe formulas and solve problems for area.
5. Describe formulas and solve problems for volume and capacity.
6. Describe formulas and solve problems for weight.
7. Convert between Imperial and Metric.

E. Ratio and Proportion, Graphs and Tables ..... 6 Hours

Outcome: ***Solve problems using ratio and proportion, graphs and tables.***

1. Describe two quantities in the form of a ratio.
2. Solve problems using ratio and proportion.
3. Convert between fractions, decimals, ratios and percentages.
4. Solve problems using taper ratios and systems.
5. Interpret information on graphs and charts.

F. Introduction to Triangles and Trigonometry ..... 8 Hours

Outcome: ***Solve problems involving special triangles and elementary trigonometry.***

1. Describe the terms and concepts used in working with triangles and trigonometry.
2. Describe special triangles and solve problems using related formulas.
3. Describe Pythagorean theory and use it to solve problems.
4. Describe trigonometric formulas and solve problems using formulas.

G. Sketches, Drawing and Prints ..... 10 Hours

Outcome: ***Interpret prints, drawings and sketches.***

1. Describe the six planes of an orthographic projection and the key view.
2. Describe first and third angle projection and recognize the ISO symbol for each projection.
3. Describe three types of pictorial views.
4. Describe the types of lines used on prints and their application.
5. Describe the application of text and dimensions to a drawing.
6. Describe the methods used to express the amount of taper on a component drawing.
7. Describe the use of sectional views.
8. Identify structural steel shapes and know how they are specified.
9. Read dimensions on prints in both metric and imperial systems and dual dimensioning.
10. Calculate for missing dimensions on a drawing.
11. Demonstrate basic sketching.

H. Limits, Fits and Tolerances.....10 Hours

Outcome: ***Read and interpret drawings containing limits, fits, tolerances and allowances.***

1. Describe limits and tolerances for parts on working drawings.
2. Describe allowances and fits for mating parts on working drawings.
3. Describe the systems of fits in imperial and metric SI terms.
4. Apply all dimensions and tolerances to a set of working drawings.
5. Interpret prints including all information generally provided on prints, shop drawings and sketches.

SECOND PERIOD TECHNICAL TRAINING
MILLWRIGHT TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE WILL BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

Due to the nature of the work of the Millwright trade it is imperative that safety, WHMIS and environmental concerns be taught on a continuous basis throughout the entirety of this course.

It is industry's intent that the practical portion of the program enhances the theory section of the course outline.

SECTION ONE:.....BEARINGS, GASKETS, SEALS AND LUBRICATION..... 48 HOURS

A. Gaskets and Piping ..... 10 Hours

Outcome: ***Demonstrate installation of gaskets, pipe and pipe fittings.***

1. Describe the safety rules and precautions applicable to the installation, removal and replacement of gaskets.
2. Describe types of gasket joints common in industry.
3. Describe types and applications of gasket materials.
4. Demonstrate joint disassembly and gasket removal and assembly techniques.
5. Demonstrate pipefitting and installation techniques.
6. Demonstrate soldering techniques.

B. Anti-Friction Bearings ..... 12 Hours

Outcome: ***Demonstrate selection and installation of anti-friction bearings for specified applications.***

1. Describe types, parts and functions of common anti-friction bearings.
2. Describe the type, size and features of anti-friction bearings from the bearing codes.
3. Determine shaft and housing sizes required to provide the correct fit to the anti-friction bearing.
4. Describe procedures for installation and removal of anti-friction bearings.
5. Demonstrate drive or press-on methods of mounting anti-friction bearings.
6. Demonstrate oil injection and hydraulic nut methods of mounting anti-friction bearings.
7. Demonstrate hot mounting procedures used to install anti-friction bearings.
8. Demonstrate procedures for setting internal clearances in anti-friction bearings.

C. Plain Bearings ..... 8 Hours

Outcome: ***Demonstrate application, installation and fitting of plain bearings.***

1. Describe construction, function and application of plain bearings.
2. Describe characteristics of common plain bearing materials.
3. Demonstrate installation and fitting of plain bearings.

D. Bearing Maintenance ..... 6 Hours

Outcome: ***Describe frequency of bearing failures.***

1. Describe symptoms and causes of bearing failure.
2. Describe bearing inspection methods.
3. Describe bearing lubrication methods.
4. Describe bearing maintenance procedures.

E. Bearing Seals and Pillow Blocks ..... 4 Hours

Outcome: ***Describe applications of bearing seals and pillow blocks.***

1. Describe types and applications of bearing seals.
2. Describe types and uses of pillow blocks.

F. Lubrication ..... 8 Hours

Outcome: ***Describe lubrication in the millwright industry.***

1. Explain the characteristics of friction.
2. Explain lubrication theory.
3. Describe properties and applications of lubricating oils.
4. Describe oil lubrication systems and their applications.
5. Describe properties and applications of lubricating greases.
6. Describe grease lubrication systems and their applications.
7. Describe characteristics and applications of dry solid lubricants.
8. Demonstrate the use of lubricants used in the millwright industry.

SECTION TWO: ..... POWER TRANSMISSION ..... 56 HOURS

A. Shafting, Fits and Accessories ..... 6 Hours

Outcome: ***Describe shafts, fits and accessories.***

1. Describe types and applications of keys and splines.
2. Describe types and applications of locking devices used with shafting.
3. Describe types, uses, selection and characteristics of shafting.
4. Describe ISO and ANSI systems of fits for shafts and hubs.

B. Couplings ..... 10 Hours

Outcome: ***Describe types, application, replacement and maintenance of couplings.***

1. Describe types and characteristics of rigid couplings.
2. Describe types and characteristics of flexible couplings.
3. Describe types and characteristics of special purpose couplings.
4. Describe coupling applications.
5. Demonstrate coupling maintenance, removal and installation procedures.

C. Clutches and Brakes ..... 8 Hours

Outcome: ***Demonstrate types, applications, replacement and maintenance of clutches and brakes.***

1. Describe types, principles of operation and applications of mechanical clutches.
2. Describe types, principles of operation and applications of hydraulic clutches.
3. Describe types, principles of operation and applications of electric clutches.
4. Describe types, principles of operation and applications of special purpose clutches.
5. Describe types, principles of operation and applications of brakes.
6. Demonstrate clutch installation and maintenance procedures.

D. Belts ..... 8 Hours

Outcome: ***Demonstrate installation and maintenance procedures for belt power transmissions systems.***

1. Describe types, construction, applications, installation and maintenance procedures of V-belts.
2. Describe types, function and applications, installation and maintenance procedures of synchronous belts.
3. Describe types, construction, application and maintenance, installation and maintenance procedures of sheaves and pulleys.
4. Demonstrate installation, removal and maintenance of belts.

E. Chains ..... 8 Hours

Outcome: ***Demonstrate installation and maintenance procedures for chain power transmissions systems.***

1. Describe types, construction, application, installation and maintenance procedures of power transmission chains.
2. Describe power transmission chain standards and selection criteria.
3. Describe types and applications, installation and maintenance procedures of chain sprockets.
4. Demonstrate installation, removal and maintenance of chains.

F. Gearing Fundamentals ..... 4 Hours

Outcome: ***Describe the terminology and characteristics of gears.***

1. Describe gear terminology.
2. Describe types and applications of gears.
3. Describe gear systems.

G. Gearing Installation and Maintenance ..... 8 Hours

Outcome: ***Demonstrate removal, installation and maintenance of gears and gearboxes.***

1. Describe gear mesh patterns.
2. Describe gear backlash principles.
3. Demonstrate removal, maintenance and installation of gears and gearboxes.

H. Variable Speed Power Transmission Devices ..... 4 Hours

Outcome: ***Describe installation and maintenance procedures for variable speed power transmission devices.***

1. Describe construction, application and maintenance of belt type variable speed units.
2. Describe construction, application and maintenance of chain type variable speed units.
3. Describe construction, application and maintenance of hydraulic type variable speed units.
4. Demonstrate removal, maintenance and installation of variable speed units.

SECTION THREE: ..... RECIPROCATING COMPRESSORS ..... 60 HOURS

A. Compressor Fundamentals ..... 12 Hours

Outcome: ***Describe the fundamentals of compressors.***

1. Describe gas theory and gas law.
2. Describe compressor classification methods.
3. Describe compressor applications.
4. Describe reciprocating compressor components.
5. Describe basic compressor system.
6. Describe basic compressor terminology.

B. Compressor Valves ..... 8 Hours

Outcome: ***Demonstrate reciprocating compressor valves design, inspection and repair.***

1. Describe compressor valve design and applications.
2. Describe inspection and testing of compressor valves.
3. Demonstrate removal, repair and installation of compressor valves.

C. Compressor Cylinder Components ..... 6 Hours

Outcome: ***Demonstrate reciprocating compressor cylinder components design, inspection and repair.***

1. Describe function, inspection and reconditioning procedures of pistons and piston rods.
2. Describe function, inspection and reconditioning procedures of cylinders.
3. Describe function, inspection and reconditioning procedures of rod packing and stuffing box.
4. Demonstrate removal, repair and installation of compressor cylinder components.

D. Compressor Crosshead and Distance Piece Components ..... 6 Hours

Outcome: ***Demonstrate reciprocating compressor crosshead and distance piece components design, inspection and repair.***

1. Describe function, inspection and reconditioning procedures of the distance piece.
2. Describe function, inspection and reconditioning procedures of the crosshead.
3. Describe function, inspection and reconditioning procedures of the connecting rod.
4. Demonstrate removal, repair and installation of compressor crosshead, connecting rod and distance piece components.

E. Compressor Crankshaft and Frame Components ..... 6 Hours

Outcome: ***Demonstrate reciprocating compressor crankshaft and frame components design, inspection and repair.***

1. Describe function, inspection and reconditioning procedures of the frame components.
2. Describe function, inspection and reconditioning procedures of the crankshaft.
3. Demonstrate removal, repair and installation of compressor crankshaft and frame components.

F. Compressor Auxiliary Systems..... 12 Hours

Outcome: ***Describe reciprocating compressor lubrication, cooling, filtration and monitoring systems.***

1. Describe function and components of compressor lubrication systems.
2. Describe compressor filtration systems.
3. Describe compressor cooling systems.
4. Describe condition monitoring systems.

G. Compressor Overhaul and Start-Up Procedures ..... 10 Hours

Outcome: ***Describe reciprocating compressor overhaul and start-up procedures.***

1. Describe reciprocating compressors safety procedures.
2. Describe manufacturer specifications and manuals.
3. Describe reciprocating compressor disassembly and reassembly procedures.
4. Describe compressor start-up procedures.
5. Describe failure analysis and monitoring techniques.

SECTION FOUR: . ALIGNMENT, CUTTING, WELDING AND NON-DESTRUCTIVE TESTING..... 36 HOURS

The content of the welding section in this course outline is not to suggest a Journeyperson Millwright should complete tasks normally performed by Journeyperson Welder. A millwright may do some tack welding (a tack weld is a weld that is adequate in size to temporarily hold components in place until it can be completely welded by a journeyperson or registered apprentice welder) as well as maintain an inventory of replacement parts

A. Cross Dial Alignment ..... 16 Hours

Outcome: ***Demonstrate cross dial method of alignment.***

1. Describe the cross dial method of alignment.
2. Demonstrate the procedure to align two machine shafts using the cross dial formula method.
3. Demonstrate the procedure to align two machine shafts using the cross dial graphical method.

B. Oxy-Fuel Equipment and Procedures ..... 8 Hours

Outcome: ***Demonstrate the use of equipment and procedures when performing heating, cutting and brazing operations.***

1. Describe personal safety devices and procedures applicable to gas welding, cutting and heating operations.
2. Describe the properties and storage of gases used for welding purposes.
3. Describe oxy-fuel system components and maintenance procedures.

4. Describe oxy-fuel cutting and welding procedures.
5. Demonstrate set-up and shutdown procedures for oxy-fuel equipment.
6. Demonstrate flame heating procedures and the use of temperature indicators.

C. Electric Arc Welding ..... 8 Hours

Outcome: ***Demonstrate the procedures and equipment used in electric arc welding operations.***

1. Describe personal safety devices and procedures applicable to electric arc welding operations.
2. Describe types of electric arc welding machines.
3. Describe types and applications of SMAW electrodes.
4. Demonstrate SMAW and GMAW welding procedures.

D. Non-Destructive Testing ..... 4 Hours

Outcome: ***Describe non-destructive testing.***

1. Describe dye penetrant testing.
2. Describe magnetic particle testing.
3. Describe radiographic testing.
4. Describe ultrasonic testing.
5. Describe eddy current testing.
6. Demonstrate non-destructive testing procedures.

SECTION FIVE: ..... MATH AND PRINT READING ..... 40 HOURS

A. Area, Volume and Capacities ..... 8 Hours

Outcome: ***Solve problems involving measurement and conversion using geometric formulas.***

1. Describe terms and concepts used in working with formulas.
2. Solve problems involving measurement and conversion using formulas.

B. Transmission of Force and Motion ..... 8 Hours

Outcome: ***Use formulas to solve trade-related problems involving the principles of the transmission of force and motion.***

1. Describe terms and concepts for working with formulas to calculate the mechanical advantage of simple machines.
2. Solve trade-related problems involving the transmission of force and motion.

C. Gas Laws and Coefficient of Linear Expansion ..... 8 Hours

Outcome: ***Apply ideal gas laws and coefficient of linear expansion principles to trade related problems.***

1. Describe the relationship between pressure, temperature and volume in an ideal gas.
2. Solve trade-related problems involving the ideal Gas Laws including Boyle's Law, Charles' Law, Gay-Lussac's Law and the Combined Gas Law.
3. Solve trade-related problems involving Pascal's Law.
4. Solve trade-related problems involving the coefficient of expansion of ferrous, non-ferrous and synthetic materials.

D. Auxiliary Views and Assembly Drawings ..... 6 Hours

Outcome: ***Sketch and interpret auxiliary views, sub assembly and assembly drawings.***

1. Describe the purpose of assembly drawings.
2. Describe the layout and features typical of assembly and sub-assembly drawings.
3. Interpret assembly and sub-assembly drawings.
4. Sketch a component in orthographic projection having an auxiliary view.

E. Single Line Drawings ..... 6 Hours

Outcome: ***Read, interpret and sketch single line drawings of piping systems.***

1. Describe piping symbols used on prints and working drawings.
2. Draw and label orthographic single-line pipe drawings and conversion to isometric drawings.

F. Basic Joints and Weld Types and Symbols ..... 4 Hours

Outcome: ***Describe basic joints and welds.***

1. Describe the five basic weld joints.
2. Describe the types of welds and their acceptable dimensions.
3. Describe weld and welding symbols and their applications.
4. Describe non-destructive testing symbols.
5. Draw and interpret weld and welding symbols.

THIRD PERIOD TECHNICAL TRAINING
MILLWRIGHT TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE WILL BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

Due to the nature of the work of the Millwright trade it is imperative that safety, WHMIS and environmental concerns be taught on a continuous basis throughout the entirety of this course.

It is industry's intent that the practical portion of the program enhances the theory section of the course outline.

SECTION ONE:.....FLUID POWER..... 88 HOURS

A. Introduction to Hydraulics .....12 Hours

Outcome: ***Describe fundamentals of industrial hydraulics.***

1. Describe hydraulic system functions.
2. Describe principles of hydraulic pressure and force.
3. Describe principles of flow.
4. Describe hydraulic energy, work, power and efficiency.
5. Describe open and closed loop circuits.
6. Draw and interpret basic hydraulic circuits.

B. Hydraulic Valves .....16 Hours

Outcome: ***Demonstrate function, application and operation of hydraulic valves.***

1. Describe application, function and operating principles of pressure control valves.
2. Describe application, function and operating principles of directional control valves.
3. Describe application, function and operating principles of flow control valves.
4. Describe application, function and operating principles of stack valves and cartridge valves.
5. Describe application, function and operating principles of proportional and servo valves.
6. Demonstrate function, application and operation of hydraulic valves.

C. Hydraulic Pumps and Actuators .....16 Hours

Outcome: ***Describe operating principles, maintenance and applications of hydraulic pumps and actuators.***

1. Describe operating principles, maintenance and applications of piston pumps.
2. Describe operating principles, maintenance and applications of vane pumps.
3. Describe operating principles, maintenance and applications of gear pumps.
4. Describe operating principles, maintenance and applications of linear actuators.
5. Describe operating principles, maintenance and applications of rotary actuators.

D. Accessories, Fluids and Seals .....8 Hours

Outcome: ***Describe accessories, fluids and methods of sealing fluids in hydraulic systems.***

1. Describe types and properties of hydraulic fluids.

2. Describe types, purpose and application of reservoirs.
3. Describe characteristics, applications and installation procedures for seals used in hydraulic components.
4. Describe methods used to specify and filter particulate fluid contaminants.
5. Describe the adverse effects of water in a hydraulic system and methods of prevention.
6. Describe the adverse effects of heat in a hydraulic system and methods of prevention.
7. Describe types, purpose and application of accumulators.

E. Troubleshooting and Maintenance ..... 12 Hours

Outcome: Demonstrate maintenance and troubleshooting of hydraulic systems.

1. Describe maintenance and troubleshooting of conventional circuits.
2. Describe basic troubleshooting of electro-hydraulic systems.
3. Demonstrate maintenance and troubleshooting of hydraulic circuits.

F. Tubing and Hoses ..... 4 Hours

Outcome: Describe fluid conductors and installation techniques.

1. Describe tube, tube fittings and installation techniques.
2. Describe flexible hose, fittings and installation techniques.

G. Pneumatic Systems ..... 10 Hours

Outcome: Demonstrate pneumatic systems.

1. Describe safety procedures necessary when working with pneumatics.
2. Describe pneumatic systems, pneumatic valves and schematics.
3. Describe pneumatic actuators.
4. Demonstrate use of pneumatic components and troubleshooting procedures.

H. Fluid Power Calculations ..... 10 Hours

Outcome Perform hydraulic calculations.

1. Calculate areas of pistons, piston rod, annulus and volume of cylinders.
2. Describe Pascal's Law and how it applies to hydraulic systems.
3. Solve problems involving force-area-pressure.
4. Solve problems involving component sizing, speed and load requirements.
5. Solve problems involving relief valve settings.
6. Solve problems involving pump torque, horsepower, efficiency, displacement and flow rate.

SECTION TWO: .....COMPRESSORS, FANS, DRYERS ..... 88 HOURS

INDUSTRIAL REFRIGERATION AND HEAT EXCHANGERS

AN APPRENTICE WILL DEMONSTRATE THE MAINTENANCE, TROUBLESHOOTING AND OVERHAUL OF ONE OR MORE OF THE FOLLOWING COMPRESSORS.

A. Screw Compressors and Lobe Blowers ..... 18 Hours

Outcome: ***Describe principles, components and maintenance of screw compressors and lobe blowers.***

1. Describe types and operating principles of screw compressors.
2. Describe screw compressor components and accessories.
3. Describe operation of screw compressor capacity control systems.
4. Describe maintenance, troubleshooting and overhaul of screw compressors.
5. Describe types and operating principles of lobe blowers.
6. Describe lobe blower components and accessories.
7. Describe maintenance, troubleshooting and overhaul of lobe blowers.

B. Vane Compressors ..... 10 Hours

Outcome: ***Describe principles, components and maintenance procedures for vane compressors.***

1. Describe types and operating principles of vane compressors.
2. Describe vane compressor components and accessories.
3. Describe maintenance, troubleshooting and overhaul of vane compressors.

C. Liquid Ring Compressors ..... 6 Hours

Outcome: ***Describe principles, components and maintenance procedures for liquid ring compressors.***

1. Describe types and operating principles of liquid ring compressors.
2. Describe liquid ring compressor components and accessories.
3. Describe maintenance, troubleshooting and overhaul of liquid ring compressors.

D. Dynamic Compressors ..... 14 Hours

Outcome: ***Describe principles, components and maintenance of centrifugal and axial flow compressors.***

1. Describe types and operating principles of centrifugal flow compressors.
2. Describe centrifugal flow compressor components and accessories.
3. Describe types and operating principles of axial flow compressors.
4. Describe axial flow compressor components and accessories.
5. Describe maintenance, troubleshooting and overhaul of centrifugal and axial flow compressors.

E. Fans ..... 8 Hours

Outcome: ***Describe principles, components and maintenance for fan and fan accessories.***

1. Describe types and operating principles of fans.
2. Describe fan components and accessories.

3. Describe maintenance, troubleshooting and repair of fans.

F. Gas and Air Dryers ..... 10 Hours

Outcome: ***Describe principles, components and maintenance for gas and air dryers and accessories.***

1. Describe gas and air dryer safety.
2. Describe principles and types of gas and air dryers.
3. Describe dryer maintenance, troubleshooting and repair.

G. Industrial Refrigeration ..... 12 Hours

Outcome: ***Describe operation, maintenance and safety related to industrial refrigeration systems.***

1. Describe principles and safe operation of compression refrigeration systems.
2. Describe components, refrigerants, lubricants and accessories of compression refrigeration systems.
3. Describe chilled water, liquids overfeed, flooded and absorption systems.
4. Describe industrial refrigeration installation and maintenance.
5. Describe maintenance of compression refrigeration systems.

H. Heat Exchangers ..... 8 Hours

Outcome: ***Describe operation and maintenance of heat exchangers.***

1. Describe the principles of heat exchange.
2. Describe types and construction of heat exchangers.
3. Describe troubleshooting, maintenance and repair of heat exchangers.

I. Insulation ..... 2 Hours

Outcome: ***Describe the use of insulation.***

1. Describe insulating materials.
2. Describe hazards of insulating materials and hazard prevention methods.
3. Describe insulation application techniques.

SECTION THREE: .....ALIGNMENT AND LEVELLING..... 30 HOURS

A. Laser Shaft Alignment ..... 10 Hours

Outcome: ***Demonstrate laser equipment to align machine shafts.***

1. Describe principles of laser equipment used for shaft and bore alignment.
2. Demonstrate set-up and use of laser alignment equipment.

B. Levelling and Bore Alignment ..... 20 Hours

Outcome: ***Demonstrate levelling and bore alignment procedures.***

1. Describe wire and optical methods of alignment.
2. Describe types of levelling equipment, applications and procedures.

3. Demonstrate levelling and bore alignment procedures.

SECTION FOUR: .....ELECTRICAL SYSTEMS AND CONTROLS ..... 34 HOURS

A. Electrical Principles ..... 10 Hours

The content of the electrical section in this course outline is not to suggest a Journeyperson Millwright should complete tasks normally performed by Journeyperson Electricians. The intent is to provide the Millwright with enough electrical knowledge so that safe decisions may be made when working on or around electrical equipment.

Outcome: Describe principles of electricity and electromagnetism.

1. Describe principles of electricity.
2. Describe principles of magnetism and electromagnetism.
3. Describe electric current, phase and cycles.
4. Describe series and parallel electrical circuits.
5. Calculate the mathematical relationship between amps, volts, ohms and watts.

B. Practical Electricity ..... 6 Hours

Outcome: Describe electrical principles and applications.

1. Describe safety procedures applicable when working on electrical equipment.
2. Describe use of circuit breakers, disconnects, overload heaters and fuses.
3. Describe principles and application of electrical test meters.
4. Describe wiring systems.
5. Describe the purpose of electrical code and provincial regulations.
6. Describe electric motor replacement and maintenance procedures.

C. Industrial Controls and Troubleshooting ..... 9 Hours

Outcome: Describe basic industrial controls and troubleshooting.

1. Describe safety procedures applicable to industrial controls.
2. Describe electrical control components and systems.
3. Describe electrical ladder diagrams and electric logic troubleshooting techniques.

D. Programmable Logic Controls (PLC)..... 9 Hours

Outcome: Describe basic PLC applications and troubleshooting.

1. Describe PLC principles and applications
2. Describe PLC interface with input and output devices.
3. Describe PLC ladder logic programs.
4. Describe PLC troubleshooting techniques.

FOURTH PERIOD TECHNICAL TRAINING
MILLWRIGHT TRADE
COURSE OUTLINE

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Due to the nature of the work of the Millwright trade it is imperative that safety, WHMIS and environmental concerns be taught on a continuous basis throughout the entirety of this course.

It is industry's intent that the practical portion of the program enhances the theory section of the course outline.

SECTION ONE:.....STATIONARY ENGINES ..... 48 HOURS

A. Stationary Engine Fundamentals ..... 8 Hours

Outcome: ***Describe fundamentals of industrial stationary engines.***

1. Describe safety procedures applicable to stationary industrial engines.
2. Describe major components of stationary industrial engines.
3. Describe engine operating principles.
4. Describe engine classifications methods.

B. Frame, Block and Cylinders ..... 6 Hours

Outcome: ***Describe components, operation and maintenance of frame, block and cylinders.***

1. Describe function, construction, inspection and repair of frame and block.
2. Describe function, construction, inspection and repair of cylinders and liners.

C. Crankshaft Assembly and Pistons ..... 6 Hours

Outcome: ***Describe components, operation and maintenance of crankshafts, pistons, and assemblies.***

1. Describe function, construction, inspection and repair of crankshaft, flywheel and harmonic balancer assembly.
2. Describe function, construction, inspection and replacement of bearings.
3. Describe function, construction, inspection and repair of connecting rods, pistons, piston pins and piston rings.

D. Cylinder Head and Valve Train ..... 6 Hours

Outcome: ***Describe components, operation and maintenance of cylinder head and valve train assemblies.***

1. Describe the function, construction, inspection and repair of camshafts and valve train.
2. Describe the function, construction, inspection and repair of valves and cylinder heads.

E. Fuel, Induction, Ignition, and Starting Systems ..... 6 Hours

Outcome: ***Describe components, operation and maintenance of fuel, induction, ignition, and starting systems.***

1. Describe function, operation, inspection and service of fuel systems.
2. Describe function, operation, inspection and service of induction systems.

3. Describe function, operation, inspection and service of ignition systems.
4. Describe function, operation, inspection and service of starting systems.

F. Exhaust, Cooling, Lubrication and Ventilation ..... 6 Hours

Outcome: ***Describe components, operation and maintenance of exhaust, cooling, lubrication and ventilation systems.***

1. Describe function, operation, inspection and service of exhaust systems.
2. Describe function operation, inspection and service of cooling systems.
3. Describe function, operation, inspection and service of lubrication systems.
4. Describe function, operation, inspection and service of crankcase ventilation systems.

G. Installation and Start-up ..... 4 Hours

Outcome: ***Demonstrate installation and start-up procedures.***

1. Describe engine installation procedures.
2. Demonstrate engine start-up procedures and checks.

H. Troubleshooting and Maintenance ..... 6 Hours

Outcome: ***Describe troubleshooting and maintenance procedures.***

1. Describe engine control systems.
2. Describe engine preventive maintenance programs.
3. Describe trouble-shooting and failure analysis.
4. Demonstrate engine disassembly and reassembly procedures and engine optimization.

SECTION TWO: ..... TURBINES AND GOVERNORS ..... 48 HOURS

A. Steam Turbines ..... 28 Hours

Outcome: ***Demonstrate principles, installation, start-up, maintenance and repair procedures for steam turbines.***

1. Describe safety procedures applicable to steam turbines.
2. Describe principles and design of steam turbines.
3. Describe operation, inspection and maintenance of steam turbine components and systems.
4. Describe auxiliary and control systems related to the operation of steam turbines.
5. Demonstrate disassembly and reassembly, inspection, servicing and maintenance procedures for steam turbines.
6. Demonstrate installation and start-up procedures for steam turbines.

B. Gas Turbines ..... 8 Hours

Outcome: ***Describe principles, installation, start-up, maintenance and repair procedures for gas turbines.***

1. Describe safety procedures applicable to gas turbines.
2. Describe principles and design of gas turbines.
3. Describe operation, inspection and maintenance of gas turbine components and systems.

4. Describe auxiliary and control systems related to the operation of gas turbines.
5. Describe disassembly and reassembly, inspection, servicing and maintenance procedures for gas turbines.
6. Describe installation and start-up procedures for gas turbines.

C. Governors ..... 12 Hours

Outcome: Demonstrate operation, installation and maintenance of governors.

1. Describe safety and maintenance procedures for turbine and stationary engine governors.
2. Describe the application of governors on stationary engines, steam turbines and gas turbines.
3. Demonstrate operating principles and adjusting procedures for governors.
4. Demonstrate operating principles and adjusting procedures for over speed trip mechanisms.

SECTION THREE: .....MACHINERY MONITORING, BALANCE AND ALIGNMENT..... 48 HOURS

A. Machinery Condition Monitoring and Analysis ..... 16 Hours

Outcome: Describe machinery condition monitoring and analysis.

1. Describe applications of vibration, oil condition and temperature analysis.
2. Describe the characteristics of vibration.
3. Demonstrate vibration measurement, trending and analysis basics.
4. Describe causes and solutions of vibration in rotating equipment.
5. Describe oil sampling and analysis procedures.
6. Describe temperature measurement and analysis procedures.

B. Balancing ..... 8 Hours

Outcome: Describe machine balancing.

1. Describe causes and effects of imbalance.
2. Describe balancing procedures.
3. Describe the single plane method of balancing.
4. Describe the two-plane vector method of balancing.

C. Advanced Alignment ..... 12 Hours

Outcome: Demonstrate alignment procedures for thermal growth and multi-machine alignment.

1. Describe techniques used to measure machine thermal and process movement.
2. Demonstrate graphical solutions for solving multi-machine shaft alignment.

D. Maintenance Planning ..... 6 Hours

Outcome: Describe maintenance planning procedures.

1. Describe estimating procedures.
2. Describe purchasing procedures.
3. Describe preventive and predictive maintenance procedures and programs.
4. Describe methods of accessing equipment information.

5. Describe software applications for industrial maintenance.

E. Analytical Troubleshooting ..... 6 Hours

Outcome: ***Describe troubleshooting procedures.***

1. Describe systematic troubleshooting processes.

SECTION FOUR: ..... PUMPS, MECHANICAL SEALS AND PACKING ..... 62 HOURS

A. Dynamic Pumps ..... 6 Hours

Outcome: ***Describe the selection for dynamic pumps.***

1. Describe dynamic pump terminology and principles.
2. Describe dynamic pump types and applications.
3. Describe performance curves on dynamic pumps.
4. Perform calculations relating to dynamic pump data.

B. Dynamic Pump Operation ..... 18 Hours

Outcome: ***Demonstrate operation, repair and maintenance for dynamic pumps.***

1. Describe dynamic pump and system components.
2. Describe dynamic pump operating conditions and requirements.
3. Demonstrate dynamic pump maintenance and repair procedures.

C. Positive Displacement Pumps ..... 18 Hours

Outcome: ***Demonstrate operation, repair and maintenance for positive displacement pumps.***

1. Describe positive displacement pump principles and applications.
2. Describe reciprocating positive displacement pumps and system components.
3. Describe rotary positive displacement pumps and system components.
4. Describe positive displacement pump operating conditions and requirements.
5. Demonstrate positive displacement pump maintenance and repair procedures.

D. Mechanical Seals ..... 7 Hours

Outcome: ***Demonstrate principles, inspection and replacement procedures for mechanical seals.***

1. Describe principles and components of mechanical seals.
2. Describe types, applications and testing of mechanical seals.
3. Demonstrate procedures for inspecting and replacing mechanical seals.

E. Compression Packing ..... 5 Hours

Outcome: ***Demonstrate principles, inspection and replacement procedures for compression packing.***

1. Describe principles and components of compression packing.
2. Describe applications of compression packing.
3. Demonstrate the procedure for re-packing pumps and valves.

F. Valves ..... 8 Hours

Outcome: ***Describe operation, maintenance and repair of fluid control valves.***

1. Describe types, application and operation of valves.
2. Describe methods of valve operation.
3. Describe valve maintenance, repair and test procedures.

SECTION FIVE: ..... MATERIAL HANDLING SYSTEMS, ... 34 HOURS
WORKPLACE COACHING SKILLS & INDUSTRY NETWORK

A. Belt Conveyors ..... 14 Hours

Outcome: ***Demonstrate application, operation and maintenance of belt conveying systems.***

1. Describe conveyor belt designs.
2. Describe conveyor belt construction, joining and repair methods.
3. Describe conveyor belt pulleys drives and take-ups.
4. Describe conveyor belt carrying and return idlers.
5. Demonstrate maintenance and adjustment procedures for conveyor belts.

B. Chain, Bucket and Screw Conveyors ..... 8 Hours

Outcome: ***Describe application, operation and maintenance of chain, bucket and screw conveying systems.***

1. Describe the construction, operation, application, accessories, maintenance and repair of chain conveyors.
2. Describe the construction, operation, application, accessories, maintenance and repair of bucket conveyors.
3. Describe the construction, operation, application, accessories, maintenance and repair of screw conveyors.

C. Roller and Pneumatic Conveyors ..... 8 Hours

Outcome: ***Describe application, operation and maintenance of roller and pneumatic conveying systems.***

1. Describe the construction, operation, application, accessories, maintenance and repair of roller and pneumatic conveyors.
2. Describe the construction, operation, application, accessories, maintenance and repair of vibrating and air slide conveyors.

D. Workplace Coaching Skills ..... 2 Hours

Outcome: ***Display coaching skills.***

1. Describe coaching skills used for training apprentices.

E. Alberta's Industry Network ..... 1 Hour

Outcome: ***Describe the role of the Alberta Apprenticeship and Industry Training Board and the network of industry committees that represent the trades and occupations in Alberta.***

1. Describe Alberta's apprenticeship and industry training system.
2. Describe the roles and responsibilities of the Alberta Apprenticeship and Industry Training Board, government and post-secondary institutions.
3. Describe the roles and responsibilities of the PACs, LACs and occupational committees.

F. Interprovincial Standards Red Seal Program ..... 1 Hour

Outcome: ***Use Red Seal products to challenge an Interprovincial examination***

1. Identify Red Seal products used to develop Interprovincial examinations.
2. Use Red Seal products to prepare for an Interprovincial examination.

Apprenticeship and Industry Training

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